REMARKS

In the Office Action of March 1, 2002, Claims 12 - 17 were rejected. No claim was allowed. In response, Claims 12 - 14 are canceled, Claims 15 and 17 are amended, and new Claims 18 - 27 are added to the application. Reexamination and reconsideration are respectfully requested in view of the foregoing amendments and the following remarks.

Support for New Claims

Claims 15 and 17 are amended to clarify that only the oxide film (e.g. the pad oxide film in Example 1, the thermal oxidation film on the substrate after formation of LOCOS in Example 2) is subjected to the heat-treatment.

Independent Claim 18 is supported by Example 2, wherein after forming LOCOS, a thermal oxide film is formed on the substrate by thermal oxidation, followed by heat-treatment in an inert atmosphere.

Independent Claim 23 is supported by Example 3, wherein after forming LOCOS, an electrode film is formed on the substrate, followed by heat-treatment in an inert atmosphere.

Accordingly, it is respectfully submitted that the amendments and new claims presented herein do not constitute new matter.

Rejection of Claim 12 - 17 under 35 U.S.C. §103(a) over Kunikiyo in view of Chiu et al

Claims 12 - 17 were rejected under 35 U.S.C. §103(a) as obvious over Kunikiyo (U.S. Patent No. 5,668,403) in view of Chiu et al (U.S. Patent No. 5,470,783). The Office Action alleges that Kunikiyo teaches a process for producing a semiconductor device that comprises the steps of: forming an element isolation oxide film on a silicon substrate by thermal oxidation using a nitride film as a mask; removing the nitride mask and thereafter carrying out a heat-treatment at a temperature of 950 °C or more in a nitrogen atmosphere to relax stress in the

isolation oxide film; and forming a gate oxide film, a source and a drain, electrode and wiring, and an insulating film so as to form a transistor.

The Examiner states that Kunikiyo differs from the claims in not disclosing that the thermal oxidation is carried out at the claimed temperature of 850 °C in an atmosphere of a gaseous mixture of hydrogen and oxygen or in an atmosphere of H_20. However, the Examiner alleges that Chiu teaches that a field oxide is grown in a conventional wet oxidation environment of $H_20 + 0_2$ or $H_2 + 0_2$ at a nominal temperature of about 800 °C to about 1000 °C. The Examiner takes the position that it would have been obvious to one having ordinary skill in the art at the time the invention was made to carry out the thermal oxidation of Kunikiyo under the condition taught by Chiu because such thermal process for forming the field oxide is conventional in the art, and the application of a known process to make the same would have been within the level of an artisan. The Examiner further alleges that the functional limitation of reducing stress in the oxide film to substantially zero recited in claim 12 is inherent in that the heat-treatment of Kunikiyo would produce the same result because Kunikiyo performs the heat-treatment under the same condition with that of the claim.

This rejection is traversed as it may apply to Claims 15 - 17 as amended herein and new Claims 18 - 27.

In the present invention, oxidation is carried out at the time of forming the LOCUS by heat treatment in an atmosphere of H_2 and O_2 or H_2O, which process is conventional. In the process, stress is retained in the oxide film. According to the present invention, the stress is relaxed by the further step of subjecting the oxide film to heat treatment at a temperature of 800 °C or higher in an inert atmosphere, which exploits the visco-elastic behavior of the oxide film. A cause of generating residual stress is the volume expansion at the time of oxide film growth. According to the heat treatment of the present invention, stress relaxation can be attained by

exploiting only the mechanical properties (viscoelasticity) of the oxide film already grown without bringing about new bonds (particularly oxidation) in the heat treatment.

In Kunikiyo, on the other hand, after forming LOCOS, the SiN film and pad oxide film are removed so as to make crystal defects (Si among lattices, dangling bonds, etc.) near interface of Si substrate disappear, followed by heat treatment at 950°C or higher in a nitrogen atmosphere (N_2O, N_2) which has the result of forming SiN bonds by nitriding so as to reduce the crystal defects and to reduce leakage current. In other words, in Kunikiyo, the nitrogen atmosphere in the heat treatment step is not an "inert atmosphere" as required by the present claims since, in the context of the Kunikiyo process, the nitrogen participates in the treatment. In the process of Kunikiyo, heat treatment in an atmosphere that does not contain nitrogen would be meaningless.

Moreover, Chui does not supply the missing element from Kunikiyo. Chui is cited as teaching an oxidation heat treatment in an atmosphere of $H_2 + O_2$ in the presence of a SiN film and pad oxide film for forming a thick oxide film. Chui does not teach or suggest a subsequent heat treatment in an inert atmosphere to relax stress.

Accordingly, it is respectfully submitted that the combination of Kunikiyo and Chui do not teach or suggest the present invention and that Claims 15 - 27 would not have been obvious over Kunikiyo and Chui, alone or in combination.

Rejection of Claim 12 - 17 under the Judicially Created Doctrine of Obviousness-type Double Patenting

Claims 12 - 17 were rejected under the judicially created doctrine of obviousness-type double patenting over Claims 2 and 5 of U.S. Patent No. 6,326,284 in view of Chui et al. The Office Action alleges that Claims 2 and 5 of U.S '284 teach substantially the claimed invention except for the limitation that thermal oxidation is carried out at the claimed temperature of 850 °C in an atmosphere of a gaseous mixture of hydrogen and oxygen or in an atmosphere of H_2O.

The Examiner alleges that Chiu teaches that a field oxide is grown in a conventional wet oxidation environment of $H_2O + O_2$ or $H_2 + O_2$ at a nominal temperature of about 800 °C to about 1000 °C. The Examiner takes the position that it would have been obvious to carry out the thermal oxidation of Kunikiyo under the condition taught by Chiu because such thermal process for forming the field oxide is conventional in the art, and the application of a known process to make the same would have been within the level of an artisan.

This rejection is respectfully traversed as it may apply to amended Claims 15 - 17 and new Claims 18 - 27. According to US 6,326,284, at least concrete gas conditions are not defined. According to Chiu et al, the heat treatment step is conducted in an oxidation atmosphere after formation of LOCOS, which step is quite different from the heat treatment used in the present invention, as discussed above.

Therefore, there is no suggestion and motivation to combine the heat treatment step of Chiu et al with the process of US 6,326,284 and, accordingly, it is respectfully submitted that Claims 15 - 17 and new Claims 18 - 27 would not have been obvious over Claims 2 and 4 of U.S. Patent No. 6,326,284 or Chui, alone or in combination.

Conclusion

In view of the foregoing amendments and remarks, it is respectfully submitted that Claims 15 - 27 are in condition for allowance. Favorable reconsideration is respectfully requested.

Should the Examiner believe that anything further is necessary to place this application in condition for allowance, the Examiner is requested to contact applicants' undersigned attorney at the telephone number listed below.

Kindly charge any additional fees due, or credit overpayment of fees, to Deposit Account No. 01-2135 (500.34397CV2).

Respectfully submitted,

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IN THE CLAIMS:

15. (Amended) A process for producing a semiconductor device which comprises forming an element-separating oxide film on a silicon substrate by thermal oxidation, and thereafter carrying out a heat-treatment at a temperature of not lower than 800°C while keeping a surface of the oxide film ~~or silicon substrate in a bare state~~ in an inert atmosphere, followed by formation of a gate oxide film, introduction of impurities, formation of electrodes and wiring, and formation of an insulating film so as to form a transistor,

wherein the heat-treatment of the oxide film is carried out ~~while keeping the oxide film or surface of silicon substrate in a bare state~~ after removal of an oxidation-preventing film, and the thermal oxidation is carried out at least in an atmosphere of a gaseous mixture of hydrogen and oxygen or in an atmosphere of H_2O.

17. (Amended) A process according to claim 15, wherein the oxide film ~~or surface of silicon substrate~~ is kept in a ~~base~~ bare state during the heat-treatment for stress relaxation.